

UNITED STATES PATENT APPLICATION

FOR

IMPROVED TRANSISTOR BACKPLANES FOR LIQUID CRYSTAL DISPLAYS

COMPRISING DIFFERENT SIZED SUBPIXELS

BY

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**IMPROVED TRANSISTOR BACKPLANES FOR LIQUID CRYSTAL DISPLAYS
COMPRISING DIFFERENT SIZED COLORED SUBPIXELS**

BACKGROUND

[01] In commonly owned United States Patent Applications: (1) United States Patent Application Serial No. 09/916,232 (“the ‘232 application”), entitled “ARRANGEMENT OF COLOR PIXELS FOR FULL COLOR IMAGING DEVICES WITH SIMPLIFIED ADDRESSING,” filed July 25, 2001; (2) United States Patent Application Serial No. 10/278,353 (“the ‘353 application”), entitled “IMPROVEMENTS TO COLOR FLAT PANEL DISPLAY SUB-PIXEL ARRANGEMENTS AND LAYOUTS FOR SUB-PIXEL RENDERING WITH INCREASED MODULATION TRANSFER FUNCTION RESPONSE,” filed October 22, 2002; (3) United States Patent Application Serial No. 10/278,352 (“the ‘352 application”), entitled “IMPROVEMENTS TO COLOR FLAT PANEL DISPLAY SUB-PIXEL ARRANGEMENTS AND LAYOUTS FOR SUB-PIXEL RENDERING WITH SPLIT BLUE SUB-PIXELS,” filed October 22, 2002; (4) United States Patent Application Serial No. 10/243,094 (“the ‘094 application), entitled “IMPROVED FOUR COLOR ARRANGEMENTS AND EMITTERS FOR SUB-PIXEL RENDERING,” filed September 13, 2002; (5) United States Patent Application Serial No. 10/278,328 (“the ‘328 application”), entitled “IMPROVEMENTS TO COLOR FLAT PANEL DISPLAY SUB-PIXEL ARRANGEMENTS AND LAYOUTS WITH REDUCED BLUE LUMINANCE WELL VISIBILITY,” filed October 22, 2002; (6) United States Patent Application Serial No. 10/278,393 (“the ‘393 application”), entitled “COLOR DISPLAY HAVING HORIZONTAL SUB-PIXEL ARRANGEMENTS AND LAYOUTS,” filed October 22, 2002; (7) United States Patent Application Serial No. 01/347,001 (“the ‘001 application”)

entitled "IMPROVED SUB-PIXEL ARRANGEMENTS FOR STRIPED DISPLAYS AND METHODS AND SYSTEMS FOR SUB-PIXEL RENDERING SAME," filed January 16, 2003, each of which is herein incorporated by reference in its entirety, novel sub-pixel arrangements are disclosed for improving the cost/performance curves for image display devices.

[02] For certain subpixel repeating groups having an even number of subpixels in a horizontal direction, the following systems and techniques to affect proper dot inversion schemes are disclosed and are herein incorporated by reference in their entirety: (1) United States Patent Application Serial Number 10/456,839 entitled "IMAGE DEGRADATION CORRECTION IN NOVEL LIQUID CRYSTAL DISPLAYS"; (2) United States Patent Application Serial No. 10/455,925 entitled "DISPLAY PANEL HAVING CROSSOVER CONNECTIONS EFFECTING DOT INVERSION"; (3) United States Patent Application Serial No. 10/455,931 entitled "SYSTEM AND METHOD OF PERFORMING DOT INVERSION WITH STANDARD DRIVERS AND BACKPLANE ON NOVEL DISPLAY PANEL LAYOUTS"; (4) United States Patent Application Serial No. 10/455,927 entitled "SYSTEM AND METHOD FOR COMPENSATING FOR VISUAL EFFECTS UPON PANELS HAVING FIXED PATTERN NOISE WITH REDUCED QUANTIZATION ERROR"; (5) United States Patent Application Serial No. 10/456,806 entitled "DOT INVERSION ON NOVEL DISPLAY PANEL LAYOUTS WITH EXTRA DRIVERS"; (6) United States Patent Application Serial No. 10/456,838 entitled "LIQUID CRYSTAL DISPLAY BACKPLANE LAYOUTS AND ADDRESSING FOR NON-STANDARD SUBPIXEL ARRANGEMENTS"; and (7) United States Patent Application Serial No. 10/696,236 entitled "IMAGE DEGRADATION CORRECTION IN NOVEL LIQUID CRYSTAL DISPLAYS WITH SPLIT BLUE SUBPIXELS", filed October 28, 2003.

[03] These improvements are particularly pronounced when coupled with sub-pixel rendering (SPR) systems and methods further disclosed in those applications and in commonly owned United States Patent Applications: (1) United States Patent Application Serial No. 10/051,612 (“the ‘612 application”), entitled “CONVERSION OF RGB PIXEL FORMAT DATA TO PENTILE MATRIX SUB-PIXEL DATA FORMAT,” filed January 16, 2002; (2) United States Patent Application Serial No. 10/150,355 (“the ‘355 application”), entitled “METHODS AND SYSTEMS FOR SUB-PIXEL RENDERING WITH GAMMA ADJUSTMENT,” filed May 17, 2002; (3) United States Patent Application Serial No. 10/215,843 (“the ‘843 application”), entitled “METHODS AND SYSTEMS FOR SUB-PIXEL RENDERING WITH ADAPTIVE FILTERING,” filed August 8, 2002; (4) United States Patent Application Serial No. 10/379,767 entitled “SYSTEMS AND METHODS FOR TEMPORAL SUB-PIXEL RENDERING OF IMAGE DATA” filed March 4, 2003; (5) United States Patent Application Serial No. 10/379,765 entitled “SYSTEMS AND METHODS FOR MOTION ADAPTIVE FILTERING,” filed March 4, 2003; (6) United States Patent Application Serial No. 10/379,766 entitled “SUB-PIXEL RENDERING SYSTEM AND METHOD FOR IMPROVED DISPLAY VIEWING ANGLES” filed March 4, 2003; (7) United States Patent Application Serial No. 10/409,413 entitled “IMAGE DATA SET WITH EMBEDDED PRE-SUBPIXEL RENDERED IMAGE” filed April 7, 2003, which are hereby incorporated herein by reference in their entirety.

[04] Improvements in gamut conversion and mapping are disclosed in commonly owned and co-pending United States Patent Applications: (1) United States Patent Application Serial No. 10/691,200 entitled “HUE ANGLE CALCULATION SYSTEM AND METHODS”,

filed October 21, 2003; (2) United States Patent Application Serial No. 10/691,377 entitled "METHOD AND APPARATUS FOR CONVERTING FROM SOURCE COLOR SPACE TO RGBW TARGET COLOR SPACE", filed October 21, 2003; (3) United States Patent Application Serial No. 10/691,396 entitled "METHOD AND APPARATUS FOR CONVERTING FROM A SOURCE COLOR SPACE TO A TARGET COLOR SPACE", filed October 21, 2003; and (4) United States Patent Application Serial No. 10/690,716 entitled "GAMUT CONVERSION SYSTEM AND METHODS" which are all hereby incorporated herein by reference in their entirety.

[05] Additional advantages have been described in (1) United States Patent Application Serial No. 10/696,235 entitled "DISPLAY SYSTEM HAVING IMPROVED MULTIPLE MODES FOR DISPLAYING IMAGE DATA FROM MULTIPLE INPUT SOURCE FORMATS", filed October 28, 2003 and (2) United States Patent Application Serial No. 10/696,026 entitled "SYSTEM AND METHOD FOR PERFORMING IMAGE RECONSTRUCTION AND SUBPIXEL RENDERING TO EFFECT SCALING FOR MULTI-MODE DISPLAY" filed October 28, 2003; which are all hereby incorporated by reference. All patent applications mentioned in this specification are hereby incorporated by reference in their entirety.

BRIEF DESCRIPTION OF THE DRAWINGS

[06] The accompanying drawings, which are incorporated in, and constitute a part of this specification illustrate exemplary implementations and embodiments of the invention and, together with the description, serve to explain principles of the invention.

[07] **FIG. 1** is an example of a display comprising a subpixel repeating unit wherein there are at least two subpixels comprising different sizes and/or dimensions and an associated TFT backplane.

[08] **FIG. 2** is one example of a display comprising at least two subpixels having different sizes/dimensions with a TFT backplane as made in accordance with the principles of the present invention.

[09] **FIG. 3** is one example of an implementation of a TFT backplane as made in accordance with the principles of the present invention.

[010] **FIG. 4** is another example of an implementation of a TFT backplane as made in accordance with the principles of the present invention.

DETAILED DESCRIPTION

[011] Reference will now be made in detail to implementations and embodiments, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[012] In commonly-owned applications listed above, there are shown display panels comprising a subpixel repeating group that further comprises subpixels of different physical dimensions. One example is shown in Figure 1. A portion of display panel 100 is depicted here as

comprising an octal repeating subpixel grouping 102 that comprises a checkerboard of red subpixels 104 and blue subpixels 108. These red and blue subpixels are larger in width than the four interspersed green subpixels 104. Each subpixel is shown as being driven by a thin film transistor (TFT) 110 in one of the corners of the subpixel.

[013] It may not be desirable to locate these TFTs in the corner of the smaller subpixels for several reasons. First, as the smaller subpixels are impacted in their aperture ratio more greatly than the larger subpixels, it might be desirable to locate their TFTs elsewhere. Second, at sufficiently high dots per inch (DPI), defects in the manufacture of TFTs for smaller sized subpixels might adversely impact the overall yield of panels having different sized subpixels. This may be especially true for amorphous silicon (a-Si) displays having pixel densities at or above approximately 150dpi. This may be adversely impact aperture ratio because of the relatively large TFT used in a-Si.

[014] Additionally, there may be some defects that arise in mask misalignments that result in the smaller (in this example, green) subpixels being more impacted over most of the panel than the larger (e.g, red and blue) subpixels. Such misalignments may create a color shift overall and could be corrected by tuning the backlight for such defective panels or by designing the manufacturing process to create up to a certain level of mask misalignment. However, moving the TFTs into the larger subpixels might alleviate to some degree the overall color shifting that might occur with mask misalignments.

[015] It should be appreciated that the principles of the present invention are applicable to any subpixel layout having subpixels of different size. In fact, the number of subpixels in the repeating group and their color assignments may be any desired and chosen. It suffices that there

are merely at least two subpixels that have different sizes/dimensional for the purpose of the present invention. Additionally, it might be desirable to locate all smaller subpixel TFTs into larger subpixel areas; or it may be desirable to locate a subset of such smaller subpixel TFTs into larger subpixel areas. It suffices that some of such smaller subpixel TFT are formed and located into larger subpixel areas. Thus, the scope of the present invention should not be limited to the particular examples of such layouts disclosed in the drawings and the specification.

[016] Figure 2 depicts one embodiment of an improved TFT layout for displays comprising subpixels of different sizes. In this embodiment, the transistors in the smaller sized subpixels are moved to reside in the area of the larger subpixels. For example, in Figure 2, it is seen that TFT 202 drives a red subpixel and blue subpixel 212 comprises TFTs 204, 206 and 208 – which might drive subpixels 210, 212 and 214. In this embodiment, the aperture ratio of the blue subpixels would be impacted more than either the smaller, green subpixels or the larger red subpixel. This arrangement might be desirable, as the color blue has less emphasis in the human visual system.

[017] Of course, it would be appreciated that other embodiments would also be suitable. For example, the red subpixels could contain all or one extra TFTs to help drive the smaller subpixels. Additionally, the plurality of TFTs placed inside the larger subpixel may be placed in different locations (e.g. lower side or different corners) of the subpixel.

[018] Additionally, other color assignments for the larger and the smaller subpixels could be arranged. As stated above, it merely suffices that there are at least two different sized subpixels of any color and that some or all of the TFTs that would drive the smaller subpixels are constructed in the areas of the larger subpixels.

[019] Figures 3 and 4 show two possible embodiments for implementations of TFTs that drive proximate smaller subpixels within a larger subpixel – such as for subpixel 212 in Figure 2. As may be seen, subpixels 210 and 214 are driven by TFTs 204 and 208 that are located with the space allocated to subpixel 212 in both Figures 3 and 4. It should be appreciated that neither Figures 3 or 4 are drawn to scale here. Additionally, it should be appreciated that there are many other possible TFT designs that would suffice for the purposes of the present invention.

[020] While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.